

The Knowledge Bank at The Ohio State University

Ohio State Engineer

Title: Geared Turbine Ore Carriers for the Great Lakes

Creators: Miller, Kenneth

Issue Date: May-1938

Publisher: Ohio State University, College of Engineering

Citation: Ohio State Engineer, vol. 21, no. 6 (May, 1938), 12-14.

URI: <http://hdl.handle.net/1811/35524>

Appears in Collections: [Ohio State Engineer: Volume 21, no. 6 \(May, 1938\)](#)

GEARED TURBINE ORE CARRIERS FOR THE GREAT LAKES

BY KENNETH MILLER

THE month of November produced the first bulk ore carriers to be built on the Great Lakes in seven years when the steamers William A. Irvin and Ralph H. Watson were launched by the American Shipbuilding Company of Lorain, and the Great Lakes Engineering Company, respectively. These ships are the first of a tentative fleet to use high pressure geared turbine drive, and the importance of the step may be realized when it is understood that the Great Lakes shipping has clung to Scotch boilers and reciprocating engines with little change for the last thirty or forty years. This far-reaching step was taken by the Pittsburgh Steamship Company after months of study and great credit is to be accorded the engineers responsible for the developments.

Since these vessels are unique in their class, and represent so many new ideas, a consideration of their major characteristics should be of considerable interest to the engineer.

As the so-called 600 footer has been a successful carrier on the Great Lakes and so that a fair comparison might be made under actual service conditions between the new vessels and the more recent of the existing standard freighters, it was decided to hold closely to similar dimensions, capacity, and speed. However a number of changes in construction have been made, particularly in the replacement of wood by steel and the adoption of electric welding of the tanks. One advantage of welding in this case is the elimination of rivet holes, since the tank tops are subject to terrific stresses and leaky rivet joints are a constant source of trouble.

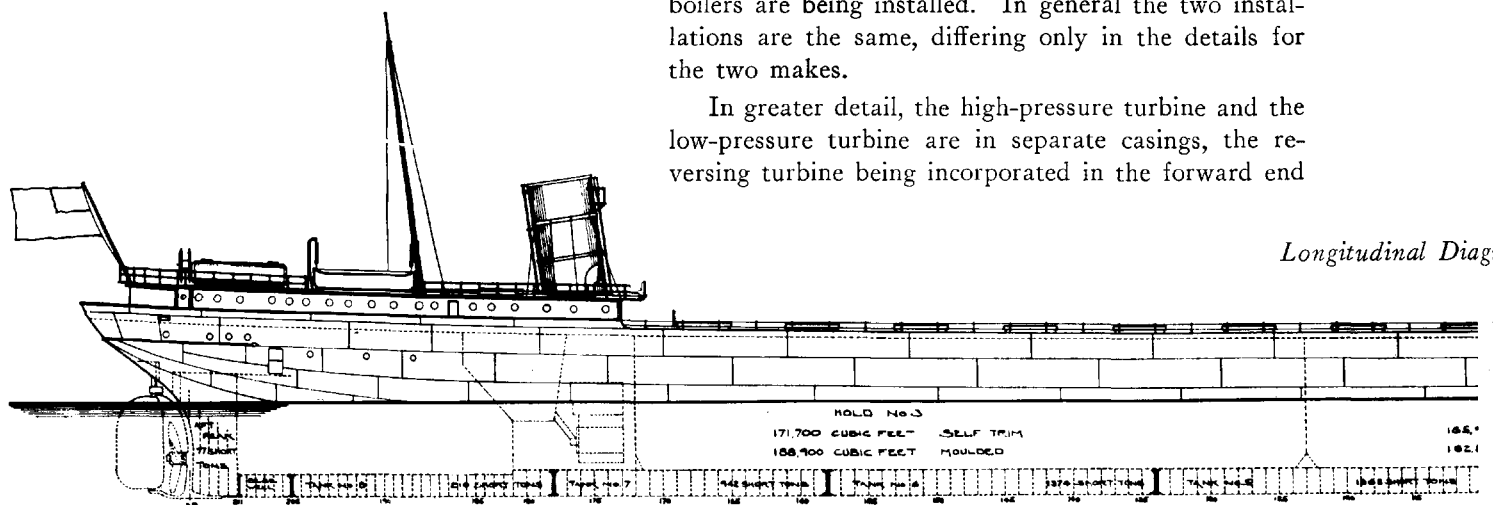
The new solid-type hatch covers will be used and

will be hauled by means of a gantry crane moving on tracks the full length of the cargo deck. The crane is electrically controlled and run by a 10 h. p. motor. It is capable of lifting five tons and moves along the deck depositing hatch covers in the open spaces between the hatches. All of the mooring winches will be electrically operated and will be of the constant-tension type driven by 35 h. p. motors. The anchor windlasses will also be electrically driven by a 55 h. p. motor, and will be capable of hoisting two 8,000-pound anchors and chains at a speed of 25 feet per minute.

Special attention has been given to officers' and crew's quarters and accommodations to make them as safe and comfortable as possible. All of the superstructure is of steel and the furniture and fittings are almost entirely of fire proof materials. The bridge deck amidship contains the first, second and third deck officers' quarters, the officers' lounge and hospital, radio room and radio operators' quarters. On the main deck are the crew's quarters, refrigerator rooms, two foam houses, one aft and one amidships. The crew's lounge is on the after boat deck. All the after quarters are so arranged that each room opens into an inside passage, thus eliminating outside doors. It is thus possible to get to any portion of the ship, including forward and aft, without going on deck.

It is in the machinery, however, both main and auxiliary, that the most sweeping changes are being made. On the vessel being built by the American Shipbuilding Company, DeLaval geared turbines and Foster-Wheeler boilers constitute the main propulsion unit, while at the Great Lakes Engineering Works, General Electric turbines and Babcock & Wilcox boilers are being installed. In general the two installations are the same, differing only in the details for the two makes.

In greater detail, the high-pressure turbine and the low-pressure turbine are in separate casings, the reversing turbine being incorporated in the forward end



of the low-pressure casing. The turbine casings are bolted to the forward end of the gear reduction, while the forward ends of the turbine casings are supported by bearing brackets in such a way that the casings are free to expand in a fore-and-aft direction with temperature changes. The high-pressure casing steam chest, and the astern steam chest are of cast steel, suitable for inlet temperature up to 750° F. In the high-pressure turbine there are eleven pressure stages, while the low-pressure turbine has seven pressure stages. The astern turbine has two pressure stages, each containing two rows of moving buckets or velocity stages. At the normal full power of 2000 shaft horsepower, the propeller speed is 90 revolutions per minute, at which speed the high-pressure turbine revolves at 5,965 revolutions per minute and the low-pressure turbine at 5,005 revolutions per minute.

The reduction gear is of the double helical type in two steps, combined in a single casing which is built in three sections and split horizontally through the plane of the reduction gear. The lower section is integral with the main Kingsbury thrust bearing housing and is arranged for attachment to the ship's structure.

In order to utilize the high efficiency of the main units for the generation of power to operate auxiliaries, a 125-kilowatt, 240-volt, 2-wire shunt wound direct-current General Electric generator is connected by means of a flexible coupling to the low-pressure second reduction pinion. In addition, two independent generating units are also installed. Each consists of a DeLaval four-stage steam turbine mounted on a common sub-base with and connected by a flexible coupling through helical reduction gears to a 125-kilowatt, 240-volt direct-current General Electric generator. The auxiliaries and turbines run at 10,000 revolutions per minute while the generators run at 1,200 revolutions per minute. Automatic controls are provided by which the load will be transferred from the main unit generator to an independent generator whenever the speed of the pinion, to which the main generator unit is coupled, exceeds 900 revolutions per minute or falls below 545 revolutions per minute.

On the vessels equipped with General Electric turbines, steam will be supplied by two Babcock & Wilcox cross-drum sectional-header boilers equipped with interdeck superheaters, economizers and air heaters, and fired by Detroit Roto stokers. These boilers are

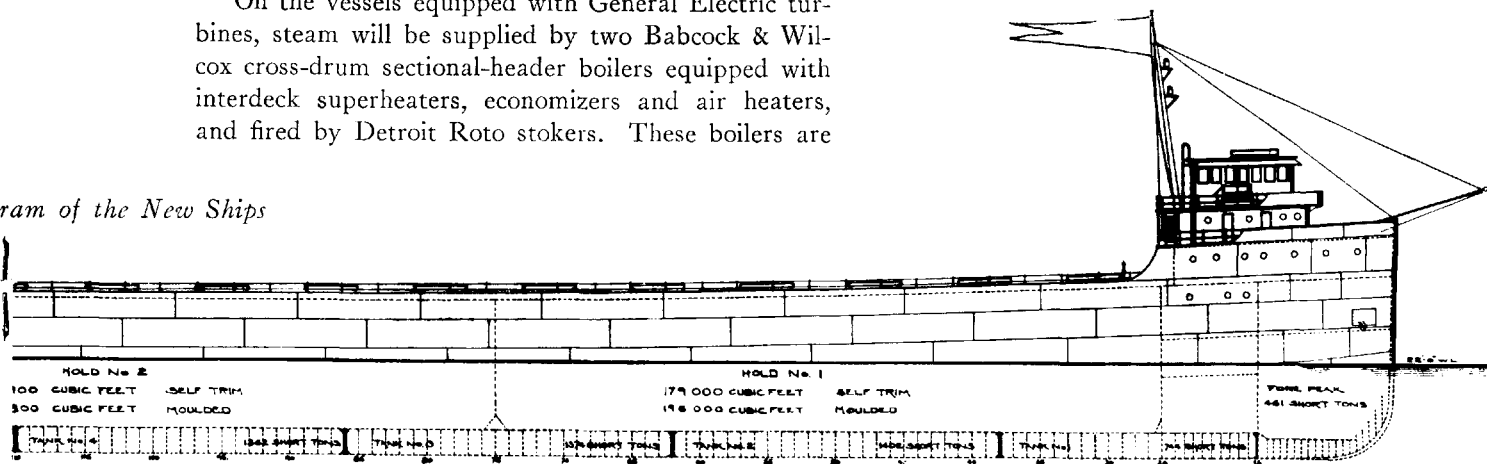
designed for a pressure of 450 pounds per square inch at 750° F., and are the first of the type having 1¼-inch tubes to be installed in Great Lakes freighters. They make possible a saving of approximately 25 per cent in weight and 25 per cent in cubical space over the older type.

The upper generating tubes of each boiler are 1¼ inches in diameter, arranged in clusters of nine tubes. Each tube of a cluster is accessible for inspection, cleaning and renewal if necessary, through a single handhole. The lower generating tubes consist of one row of clusters of four 2-inch tubes immediately below the interdeck superheater, and two rows of 3¼-inch tubes directly over the furnace. The circulating tubes extending from the rear headers to the drum are 4 inches in diameter. All tubes are straight, except the circulating tubes and the outer tubes of each 1¼-inch group, which are bent slightly at each end in order to secure a uniform spacing of the tubes across the boiler. They are equipped with Bailey superheat control and metering equipment. The furnace is of Bailey water-cooled construction, having block-covered tubes at the fuel-bed line of the stoker, and partially studded and refractory protected tubes in the upper section.

The steam generators for the vessels being built by the American Ship Building Company will be of the two drum "D"-type, burning coal with stoker firing. This is the first use of such boilers on the Great Lakes although oil fired units of this design have shown efficiencies exceeding 87 per cent in service, and are therefore among the most effective marine generators in service.

The stoker is of the spreader type having two feeders, one serving each side of the grate. Air for combustion enters from the rear, below the grates, and is controlled by two dampers, one for each side. In this way, the fires may be cleaned by shutting down one feeder and the corresponding air supply while removing ash and clinkers. This permits operating one half of the grate at full capacity while cleaning the other half.

ram of the New Ships



—Courtesy of Nautical Gazette.

The superheater consists of a series of 1¼-inch bare tubes bent into U-shape and placed horizontally in the space provided. Vertical headers are at the back of the boiler setting and access doors at the front, thus providing for removal and replacement of any superheater element, without disturbing any other element, should that ever be necessary. The steel plate baffles in the boiler and the superheater supports are of heat-resisting alloy. Each boiler drum is to be fitted with a desuperheater having capacity to provide 4500 pounds of steam per hour at a temperature not exceeding 500° F.

Soot blowers of mechanical type are installed to keep the boiler and superheater heating surfaces clean and maintain effective heat transfer.

The engine room auxiliaries for regular use in the new ships will be electrically driven while the standby equipment will be principally steam driven.

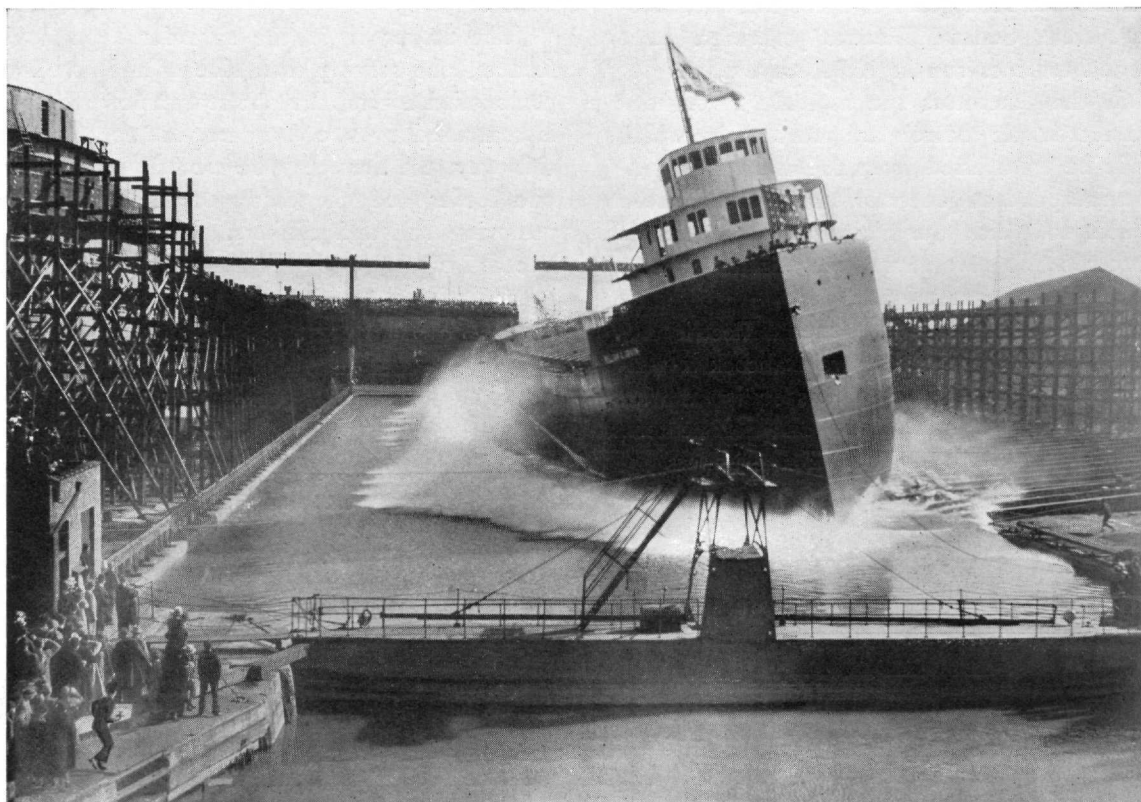
The ships are built with a double bottom and side tanks fitted to practically the entire length. This is to provide space for carrying water ballast. This water ballast is divided into nine tanks, port and starboard, by means of a continuous center line division and athwartship bulkheads. The total ballast that can be carried is over 9000 long tons of water. Each tank is fitted with an 8-inch suction and filling pipe. These pipes all come together in the engine room and are connected to a large double valve manifold.

Both ships will be fitted with hydro-electric steering gear consisting of two motor driven oil pumps directly

connected to 35 h. p. motors, one pump to be used as a standby unit. These pumps deliver oil at high pressure through a control valve mechanism to two large oil cylinders having plungers directly connected to a tiller arm on the rudder stock, the control valve being operated by oil pressure transmitted from the steering wheel stand in the pilot house. The control valve permits the main pump pressure to be exerted on one or the other of the oil cylinders causing the rudder to turn. By means of a suitable follow-up mechanism, the control valve is returned to the closed position, holding the rudder in the position chosen by the helmsman until a further movement of the steering wheel is made. The power steering engine can also be controlled from an auxiliary steering wheel on the after deck house roof or from a control wheel in the steering engine room. In case of failure of the power steering engine, the ship can be steered by hand from another steering wheel on the after deck house roof.

In summary, the new ships will have outstanding advantages over the older type of equipment. The fuel consumption will be about half the usual at the present time, the mechanical operation will be smooth, without vibration, and efficient, and the care and maintenance will be at a minimum. As a result, their operation during this season will be watched with a great deal of interest by ship owners, and if they live up to their designers' expectations, there is no doubt that this type of machinery will gradually supplant the old steam engine type now in use on the Great Lakes.

Launching of the William A. Irvin at Lorain, Ohio



—Courtesy of Heat Engineering.
THE OHIO STATE ENGINEER